DOCUMENT RESUME

ED 465 370 IR 021 380

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TITLE The Coconut Wireless Project: Sharing Culturally Responsive Pedagogy through the World Wide Web.
INSTITUTION Pacific Resources for Education and Learning, Honolulu, HI.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO ES0004
PUB DATE 2000-06-00
NOTE 19p.
CONTRACT R168R50023; S283A5001
PUB TYPE Information Analyses (070)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Cultural Activities; Elementary Education; Instructional Design; Instructional Development; Instructional Innovation; Learning Activities; *Science Instruction; *Teaching Methods; World Wide Web
IDENTIFIERS *Chamorros

ABSTRACT

Beginning in the 1997-98 school year, WestEd staff, with the support of the Pacific Resources for Education and Learning (PREL), worked intensively with a group of five Chamorro teachers from Rota Elementary School (Hawaii) to develop culturally responsive, standards-based science units. The larger goal was to develop Web-based case examples of culturally responsive science pedagogy that draws upon students' culture-based content knowledge and uses instructional methods compatible with those that are used at home and in the community. The Chamorro teachers decided that the coconut tree could serve as the basis for units across the grades, so they named the project the "Coconut Wireless." These culture-based units would be taught in conjunction with Chamorro Week, observed in the schools during May each year. This document reports on the Coconut Wireless Project. Discussion highlights include: documenting culturally responsive pedagogy in order to share with others; use of technology to capture instruction; instructional foci for Web-based examples; creating storyboards; what is on the Web page; standards addressed by the Coconut Wireless units; linking the project to ongoing local standards development; strategies for assessment of student learning; common threads across teachers' successful pedagogy; the support of the principal; value of the Coconut Wireless Project to empower teacher leadership; value of the Project for students; and recommendations. Six tables present information on: learning about local plants; frequently asked questions; elements of sixth-grade Coconut Tree unit; beginning the storyboard process; successful pedagogical strategies; and elements of success in the Coconut Wireless Project. (AEF)

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By Sharon Nelson-Barber, Elise Trumbull, and Richard Wenn*

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PACIFIC RESOURCES FOR EDUCATION AND LEARNING

Pacific Comprehensive Assistance Center Region XV
Pacific Mathematics and Science Regional Consortium

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This product was funded by the Office of Elementary and Secondary Education (OESE), U.S. Department of Education, under the Comprehensive Assistance Center program, grant number S283A5001 (CFDA 84.283A), and by the Office of Educational Research and Improvement (OERI), U.S. Department of Education, under the Eisenhower Mathematics and Science Regional Consortium program, grant number R168R50023 (CFDA 84.168R). The content does not necessarily reflect the views of OESE, OERI, the Department, or any other agency of the U.S. government.

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Beginning in the 1997-98 school year, WestEd staff, with the support of Pacific Resources for Education and Learning (PREL), worked intensively with a group of five Chamorro teachers from Rota Elementary School to develop culturally responsive, standards-based science units. The larger goal was to develop web-based case examples of culturally responsive science pedagogy, that draws upon students' culture-based content knowledge and uses instructional methods compatible with those that are used at home and in the community. The Commonwealth of the Northern Mariana Islands (CNMI), like other Pacific islands, has many teachers who come from the same indigenous cultural backgrounds as their students and who speak their home languages. Such teachers can enhance their teaching by drawing upon the cultural and linguistic strengths of their students.

The Chamorro teachers decided, after some discussion, that the **coconut tree** could serve as the basis for units across the grades, so they named the project the "Coconut Wireless." These culture-based units would be taught in conjunction with Chamorro Week, observed in the schools during May each year. We then worked through the science standards to determine which ones would be addressed at different grade levels. Teachers also thought of additional instructional content that could easily and sensibly be included in the units, and that would strengthen the link to standards. As part of the process of aligning instruction with standards, we asked teachers to consider how they might assess students' learning; they identified points in instruction where they would want to conduct assessment, as well as methods for doing so. The teachers said it was helpful to go through the process of mapping back and forth between their curriculum plans (for the unit) and the standards. They became more and more familiar with the standards, and discussed what each one meant in the context of the proposed units. Teachers are currently clarifying performance standards, i.e., criteria for determining the quality of a student performance.

Though these teachers used their culture-based knowledge to develop science lessons, the principles and processes they observed can apply to any subject area. Table 1 shows how a Chamorro teacher used culturally appropriate content and processes to teach botanical concepts.

Table 1. Learning about Local Plants

A second-grade class was learning about basic botany— the parts of plants and how they grow. The teacher decided to focus on root plants, many of which are an important home-grown staple on the island on which students live. She used the local standards as a guide for her planning and the textbook as a resource, to be sure that she addressed the essential concepts. The teacher asked students to choose which crops they wanted to plant. Students based their decisions on everyday life with their parents. As a group, they chose onions and taro. They rooted the taro in water, and put the onion in soil. They observed the outcomes of their own decisions over several weeks.

Culturally appropriate content: plants native to the local environment and meaningful in daily life

Culturally appropriate teaching methods: cooperative group planning and decision-making; student willingness to take responsibility; student observation of outcomes as feedback; and feedback to whole group vs. individuals

Documenting Culturally Responsive Pedagogy in Order to Share with Others

The team soon discovered that it was necessary to do more than create textual "cases" of teaching, if learning was to be shared effectively with other teachers. The teachers desired a mechanism for sharing their findings across classrooms, schools, and islands. They agreed that examples of their teaching could "come alive" using a web-based format, which could be augmented and manipulated at will for a teacher's purposes. The group set out to translate samples of their teaching into a series of web pages, which are flexible and iterative (the web site format accommodates ongoing development), and which capitalize on technology that already exists in most CNMI schools.

WestEd staff and Rota teachers collected images using digital cameras and recording equipment and wrote accompanying text, creating storyboards of learning in real settings. Follow-up work is expected to involve training that will teach these processes to other teachers. Teachers in the participating schools as well as in other Pacific entities will learn ways to use their own technology to select and edit case information, build their own web pages, and even develop their own CD-ROMs. End products could be placed on CD-ROM diskettes for distribution and/or transferred to computer hard drives.

Use of Technology to Capture Instruction

At the beginning of the project, Rota Elementary School had a 1:18 computer-to-student ratio, but these IBM computers had significant limitations and were not networked to a phone line. (We subsequently learned that Rota has fiber optic cable, which holds promise for improved Internet-based work.) Luckily, a relatively new machine, which was available to teachers, was linked to the Internet, allowing access to the World Wide Web. The teachers practiced logging on to the Internet and identifying and reviewing types of available technological resources that might be useful to them or their students. The group also discussed improving teacher access to the computer, using the Internet for staff development and networking with others. To facilitate collaboration, Computer Lab staff introduced the teachers to EdGateway, a web environment developed to encourage collaboration through the World Wide Web and the Internet. Table 2 shows questions and answers about the kinds of issues schools or districts may need to consider.

Table 2. Frequently Asked Questions

What kind of equipment and access to the Internet would a school/district need in order to do what the Rota teachers are doing?

Schools need computers with Macintosh or Windows operating systems and Netscape or Explorer web browsers that are version 3.0 or better, along with a consistent 28.8 modem connected to an Internet Service Provider. They can use any digital camera capable of transferring images to a PC, where they can be saved as GIF or JPEG images.

What kind of access to the equipment do teachers need in order to make this work?

Regular access is required for a successful project. Teachers need to be able to access a computer with Internet connection on a daily basis at times when their classes are not in session. Otherwise, they will not be able to involve their students in the process or stay involved in the conversation.

What is the importance of having a local person who has some expertise with the technology? What kind of training might be needed?

Teachers need to know how to access the Internet using a web browser and how to operate a digital camera. Participating teachers need a local support person who can answer questions or demonstrate trouble-shooting techniques.

How do digital cameras work?

They work like regular cameras, but instead of using film, they save images electronically, allowing the photographer to transfer the image to a computer, where it can be retrieved as needed.

Instructional Foci for Web-Based Examples

As mentioned, the group decided to use the coconut tree as a theme at the core of a set of lessons across grades. They talked about science and cultural content knowledge of the coconut, such as how coconut trees that are farther from the ocean have sweeter meat and how different coconuts stain the hands with different colors (some stains fade more quickly than others). They also discussed related topics such as cooking traditional foods, exploring Chamorro games, or doing Internet research on plants used for medicine or foods *(Which are non-poisonous? Which parts of trees/plants are used? How would you turn some part of the coconut plant into a commercial product?)*. Teachers suggested trying to find ways for small groups of students to work together on Internet research. Students might find coconut-related web sites linked to different aspects of the unit and then write about their findings or respond to a series of questions about coconuts. Teachers also talked about integrating art in lessons—a very successful approach with some students—and photographing student artwork.

Chamorro Week, which takes place in CNMI schools each May, is devoted to this kind of exploration of local culture. It was the perfect opportunity to carry out the suggested project activities—integrating local culture and teaching solid science content. To accomplish the kinds of goals the teachers had begun to identify, they felt it should be extended to two weeks; some had already informally extended it beyond the officially designated week. One teacher had developed a theme unit on the coconut plant for sixth-grade students, and she intended to work with two sixth-grade instructors to teach the unit over a period of two weeks. Table 3 shows the elements of the unit that the teacher planned and carried out.

TABLE 3. ELEMENTS OF SIXTH-GRADE COCONUT TREE UNIT

- Use authentic materials gathered from community elders
- Teach parts of the coconut tree
- Teach uses of each part of the tree
- Teach specialized vocabulary related to the coconut tree (in Chamorro and English)
- Take the class on field trips to several locations to observe different species of coconut trees and different stages of growth
- Make coconut tree products such as woven baskets and ornaments (from leaves)

A first-grade teacher talked about modifying the unit for lower grades. For example, during the first week students would observe and tell stories. The second week would be devoted to hands-on activities—learning how to use different parts of the coconut. Older students might learn about weaving coconut fronds to make fishnets, and younger students might learn less complex weaving patterns, such as those appropriate for noisemakers or watchbands. For "show-and-tell," children might be asked to bring from home things made from the coconut plant—ashtrays made from leaves and shells; woven items such as slippers; and toothpicks, brooms, and other objects. A field trip to a farm might also be planned, where the farmer could show the stages of coconut tree growth. On the last day, students would have a fiesta with food made from coconuts. Adults could participate as well, demonstrating techniques for making coconut oil and coconut candy.

A seventh-grade teacher planned to focus on foods made with coconut. She would ask parents to write the recipe for at least one dish containing some part of the coconut (oil, meat, milk). The students would make a dish and present it, demonstrating how to prepare it. If the teacher asked, "*How would rice cakes be different if you used yeast vs. coconut wine?*" then students would have to engage in some scientific analysis to answer the question. Via the web page, she could show students new possibilities by doing research on how other cultures use the coconut.

Lessons could be developed for grade clusters: K-1, 2-3, 4-6, 7-8, and so forth. Presenters might talk about using the bark from coconut trees for medicine, or burning the coconut palm to chase away evil spirits. Other instruction could be organized around types of coconut trees and their uses, properties, growing cycles, and products. In upper grades, students might look into how to develop a commercial product and market it (business math). They could be asked to write about the coconut at various levels of difficulty, and their compositions could be presented as a book with chapters, with different chapters for different grade levels or on different topics. The point is that a single theme—the coconut—could be used across different grades to craft a first set of examples for the web.

The teachers reveled in this new level of instructional decision-making. Before working with this project, they realized that they had been drawing on their own intuitions to select meaningful science content and engage students. Now, working with heightened awareness, they were making their strategies explicit, and in doing so, they could readily share their effective ways of teaching content that incorporates local culture. It is clear that these teachers envision extending these approaches well beyond Chamorro Week, to other subjects, other teachers, and other entities.

Creating Storyboards

Storyboards of completed work could be made accessible to other teachers throughout the Pacific and the continental U.S. through EdGateway. Storyboarding is a simple technique for illustrating the parts of a process or story (i.e., mapping out the unit or sub-unit to be illustrated). If one wants to show the steps of harvesting coconut and using parts of the plant to make products, it might begin like this:

Table 4. Beginning the Storyboard Process

- Identify the type of coconut you want to portray and the stages at which it is harvested.
- Have students draw each stage, and then photograph their drawings.

Step 1	Locate a stand of trees and obtain rights to harvest.
Step 2	Identify which parts of the plant/tree (and what quantity) will be needed for different products.
Step 3	Gather the parts needed (e.g., leaves for weaving mats)
	Continue on through several more steps....

Part of storyboarding entails noting where photographs, drawings, and/or narration should be placed. It is important to photograph the steps involved in turning raw materials into usable products (e.g., weaving, making coconut oil). Part of the process of making products is selecting good materials *(Which leaves are good for weaving?)*. Photos of the process are appropriate in order to place the unit in context for the reader.

In addition to photographs, participants might consider other kinds of documentation—audiotape or videotape, for example. Outside assistance may be needed to obtain supplies (audiotapes, battery charger, etc.). Part of the narration will probably have to do with why this topic is a good one for science instruction and why it is culturally appropriate. In connection with deciding on content of the unit(s), teachers will have to determine which science (and other) standards are being addressed. This may be a back-and-forth process. If an activity or sub-topic cannot be linked to one or more standards, perhaps it should not be used.

What's on the Web Page?

The photos mapping the teachers' steps in instruction would be shown in sequence on the web page. The web page could have a section on stories, both old and new (ones created by children as well as traditional ones). A section on information about coconuts could have many topics linking to it, such as the creation of coconut products, worldwide coconut distribution, characteristics of coconuts, and uses of coconut parts (which could include use as medicines, oils, and cosmetics, for example).

Standards Addressed by the Coconut Wireless Units

A key feature of the Coconut Wireless Project is its emphasis on alignment of instruction and assessment with existing CNMI K-12 Science Standards. Teachers had expected that some mathematics standards would be addressed (e.g., measurement), but the emphasis was on science standards. As mentioned, the teachers in the Rota schools already had a practice of observing Chamorro Week. During this week, students engage in activities related to Chamorro culture, such as preparing traditional foods, visiting historic sites, or learning from elders how to make certain handicrafts. Inherent in these activities are many mathematical and scientific concepts and skills, but teachers had not explicitly identified them and connected them to standards they were addressing through the curriculum.

We spent considerable time as a group identifying the standards that would be addressed through the coconut units at each grade cluster and discussing how student learning would be assessed. Recognizing that each entity has devised its own standards, this work links with the following CNMI standards—some at lower and upper grade levels, some only at upper grades:

> *Standard 1: Science as Inquiry:* Observe, describe, and conduct systematic investigation carefully; explore phenomena using sensory, manipulative, and process skills; design and execute valid experiments; and communicate results/data accurately.

Students in grades K-6 will be visiting coconut groves and making observations; they will note different types of trees and coconuts and learn the meaning of the differences. Some of these skills will come into the cooking activities at grades 7-8.

> *Standard 2: Habits of Mind:* Plan and conduct a simple investigation; use simple tools to gather data; describe things and compare observations; realize that people have always had questions about their world; know that science is one way of answering questions and explaining the natural world.

When students hear traditional stories and songs about the coconut, they can compare how those traditional depictions of nature are similar to or different from scientific ways of describing and explaining. They will be using observational skills, and skills for describing and comparing, when they collect types of coconuts, when they use ingredients to cook, and when they evaluate their dishes.

> *Standard 3: Science Connection:* Make connections to culture and other disciplines; define problems and investigate complex phenomena; think about a whole in terms of its parts and about parts in terms of how they relate to one another and to the whole.

Students in grades K-4 will be learning about the parts of the coconut tree and how the whole tree functions, as well as about the tree within its ecological setting (another part-whole relationship).

> *Standard 5: Matter: Its Structure and Changes*: Describe objects in terms of their physical properties—grades K-4; explain how matter exists as solids, liquids, and gases, each of which has different properties, and explain that changes can occur in the properties and states under the right conditions—grades 5-8.

Younger students will have opportunities to describe components of the coconut and coconut tree in physical terms. When older students are cooking or making coconut oil, they will have opportunities to observe and discuss changes in matter.

> *Standard 10: Living Environment:* Understand and appreciate the diversity and unity of living things, and recognize that organisms belong to groups and subgroups based on similarities and differences of their structures and behavior—grades K-4; demonstrate understanding that plants and animals have a great variety of body parts and internal structures, and focus on biology of coconut plants—grades 5-8.

Students will learn a lot about the living environment, whether they are learning about the specific characteristics of coconut trees or about the environment in which they live.

> *Standard 12: The Human Society*: Understand that Pacific societies differ from place to place and are in a constant state of change; explain how many traditional practices are based upon knowledge developed through years of study and observation of the environment; recognize that cultural rules and systems developed by Pacific Islanders over time allowed them to survive while maintaining their fragile environments; recognize each culture's distinctive patterns of behavior.

Studying the coconut tree gives students an excellent opportunity to explore environmental practices and recognize how Rotans have developed strategies to preserve and protect their island.

Perhaps while cultural crafts are being made or observed in the making, teachers can talk about how materials were harvested in a way that did not disturb the tree.

Linking the Project to Ongoing Local Standards Development

This project came at a perfect time for the Rota teachers, because they were in the process of writing local science standards tailored to their own community and setting benchmarks for different grades. Two of the teachers participating in the Coconut Wireless Project were also on the standards-writing committee and were able to serve as liaisons between the two activities. It is not uncommon for a district to have several innovations simultaneously under development, but their goals are not always mutually supportive, and they are not always coordinated with each other. In this case, the standards writing and the Coconut Wireless activities had mutually harmonious goals *and* the opportunity to be coordinated. As a result, the two projects could benefit each other. As with any innovation, it is crucial for administrators and faculty to consider how the new units fit with local priorities and how they will be integrated with other efforts.

Strategies for Assessment of Student Learning

We want to review a few of the strategies that teachers used for assessing students, particularly those that can be captured for use on the web. Teachers believe that students' ability to work well in a group should be evaluated. They look at *if* and *how* everyone is participating. In the case of cooking and creating objects such as woven mats, an actual product can be evaluated: *Does it look good? Does it taste good?* But process is important as well. For example, in evaluating students' basket-making, teachers want to look at the steps, the processes, *and* the product—not just the product.

Teachers use group discussion as an indicator of learning (observing which students participate and what they have to say), but they note that some students do better in individual discussion with the teacher or another student. They also allow students to draw, construct dioramas, or otherwise demonstrate what they have learned. If the medium of assessment is drawing, students should discuss their drawing with the teacher or talk in front of the group if they feel comfortable. Some may per-

form best in a cooperative group. Another method of assessment is for the teacher to walk around the room and listen to small-group conversations.

Written assessment, e.g., writing the steps in carrying out a recipe, is sometimes appropriate. One teacher planned to have students' cooking evaluated by a panel of three judges from the community. They would contribute their expert judgment, tasting among themselves.

Self-assessment and peer assessment are also used at times: a student writes what the activity objective is and assesses how well he/she (or a peer) has achieved it. This could be done orally as well. Some teachers also use reflection, one-on-one (teacher-student) or in a small group. Teachers say that a student's relationship with the teacher is very important in eliciting student performance or getting a student to evaluate his/her own performance.

All of these methods lend themselves to description through photographs of students and their work, accompanied by short narratives to explain the context.

Common Threads Across Teachers' Successful Pedagogy

Throughout the instructional and assessment strategies used by the Coconut Wireless Project, teachers form common threads of practice. They reflect on what other CNMI teachers have recommended in interviews or during regional conferences or school-based workshops. Many teachers believe that thematic instruction, in which content from more than one discipline (particularly cultural content) is integrated, is a culturally harmonious and productive teaching method. The Coconut Wireless approach lends itself to incorporating many different disciplines and a variety of modes of instruction and learning—oral and written language, visual representation, student art, and the like. Table 5 summarizes the most commonly cited strategies.

Table 5. Successful Pedagogical Strategies

- Linked to students' experiences at home
- More visual, less verbal—(e.g., using art)
- Cooperative, not competitive; group sharing (including large social groups)
- Thematic and integrated instruction (cultural activities integrated with subject matter rather than added on)
- Hands-on
- Teaching through demonstration
- Non-standardized testing; showing learning in "real-life" situations; teachers as observers
- Not reliant on textbooks (e.g., using authentic materials from community)

The Support of the Principal: Key to Success

To be successful, an innovation requires the ongoing support of the school principal and other relevant administrators. In reality, projects develop over time, and the potential of a project is not always clear at the outset. A school principal has to make a judgment about the possible benefits of an innovation, usually without fully knowing how it may pan out. For this reason and others, it is important to have continuing communication with the principal—not just initial approval to move ahead. Principals will need to know the emerging implications for their budgets: *How much money may be needed for equipment (new or upgraded), infrastructure (such as phone lines into particular classrooms or facilities), or teacher professional development beyond what was planned?*

While the principal does not necessarily need to know every detail of project implementation or acquire all technical skills (e.g., know how to transfer digital photographs to the computer), he or she needs to have a grasp of all of the project's elements and desired outcomes. Only then can he or she make informed decisions about allocating money and time—and time is equally hard to come by—for professional development, equipment, and the like. We recommend that for every important encounter with teachers, consultants make sure to meet with the principal, even if only briefly.

Value of the Coconut Wireless to Empower Teacher Leadership

To share their experiences beyond the local context, two project teachers presented their work in a two-hour workshop at the 16th Annual Pacific Educational Conference in Saipan, CNMI, in July 1999. We believe it is important to describe the presentation, because it is an index of the degree to which project teachers were able to take leadership in the project and teach its principles to others. Such an experience is an important indicator of the potential impact of this local work. It can also offer some guidelines for others who wish to present their own work.

After beginning with a "coconut" ice breaker *(What do you like to do with the coconut?)*, presenters reviewed their objectives for the session:

- Enable teachers to work together to develop and share lesson plans that integrate Chamorro cultural practices and traditions in a variety of content areas, and share them through the World Wide Web.
- Develop teachers' abilities to use the World Wide Web for classroom-based research activities with students.

Large, colorful, hand-drawn illustrations of the stages of development of the coconut tree and its parts were spread across the chalk tray in the classroom where the presentation took place. Copies of the Pacific Science Standards (relevant to the lessons taught during Chamorro Week) were given to participants. The teachers also shared a sample coconut lesson plan that had been used with first and second grades and invited the group to use this to stimulate their thinking about how they link content to their students' cultures in their own classrooms.

The two teachers took turns addressing the following important successful elements in their own project:

- Planning for Chamorro Week, and developing a realistic lesson plan;
- Ensuring that curriculum activities are aligned with science standards, and identifying those standards in advance;

- Planning how assessment will take place in order to determine the degree to which standards have been met;
- Dealing with the logistics of teaching, and working with a colleague to document one's teaching;
- Reflecting on the success of the lesson plan, and modifying and improving it for the next year.

The teachers also discussed the importance of reducing reliance on textbooks. If culture is to be incorporated in pedagogy, textbooks cannot be the sole or primary source of instruction. They noted some of the positive outcomes of the project:

- Students truly enjoyed the activities and the learning.
- Teachers found opportunities to integrate several disciplines, not only science.
- Many parents became involved.
- Students did their own "research" for homework and also made "show-and-tell" presentations.
- The photographs that teachers took during Chamorro Week could be shared with other teachers to show what had happened and to spark interest.
- The photographs suggested the kinds of "stories" of instruction that could be shared through the web site.

Teachers gave numerous examples of instruction, illustrated by photographs, that could be viewed on the laptop computers around the room. They described forms of assessment they had used: student journals, presentations, discussions, and artwork, among others. One teacher explained how she had used the week prior to Chamorro Week to tap students' prior knowledge and prime them for inquiry. She enticed students by using one of their favorite books, *The Giving Tree* by Shel Silverstein, to draw parallels to a book she had written and illustrated, *The Legend of the Coconut*. Then, explicit study of the coconut tree began: the class wrote a letter requesting information from the Cultural Affairs Agency; parents came to school and showed how to make things from parts of the coconut; students learned the parts and stages of development of the tree; everyone learned "The Coconut Song," which describes the stages; and at the end, all students made a presentation to the class.

All of the workshop participants had a chance to use the computers, log onto EdGateway and see the Coconut Wireless site, and sign up as future web communicators with the Rota teachers. In the next phase of the session, the presenting teachers asked the participants to form small groups and try to design their own culturally responsive mini-lessons, based on their own settings. Resulting lessons dealt with fishing, setting up an aquarium in the classroom, endangered species, the breadfruit, and uses of the coconut.

Participants were given the opportunity to try out the Internet information system used by the Rota teachers to coordinate activities, share information, and develop sample lessons, using digital cameras formatted for the web. Each participant created a culturally responsive lesson, and most signed on to continue to share information through the Internet. Participants were offered two continuing education units through the College of Micronesia for attending and completing session requirements. The Rota teachers hope to continue communicating with this group for ongoing sharing and professional development.

Value of the Coconut Wireless Project for Students

While our emphasis here is on the teachers, their activities during Chamorro Week, and how they have translated their lesson plans and documentation into web-based examples of pedagogy, we must mention the potential impact of the project on students. CNMI teachers stress that it is important to take students beyond textbooks, especially when the textbooks do not include anything about their indigenous language and culture. There is a need for indigenous materials, i.e., texts and stories in Chamorro. Student involvement is important in this process. As students take photos, they play a role in gathering cultural information. They can see themselves as connected with the larger world, not isolated. An administrator observed,

> "Rota is not the only or most important place in the world. They need to be exposed to other things, but need to be able to think for themselves, not follow others mindlessly. [They need to] examine new behaviors, attitudes brought in from the outside world … to maintain [their] own values. Selective adoption of outside influences can be a desirable thing. We need to help kids stay grounded but make their own lives/places even better. Many innovations come and last for a while, then go away. What are the values of this? How can we incorporate it into what we do and not make it an extra burden? It's not black and white with Chamorro good and the other bad."

The teachers agree that Rotans don't want to lose their own culture while they are learning to be citizens of the world.

Summary and Recommendations to Others

Like schools on the mainland, Pacific schools regard high technology as a way to support improved teaching and learning. The Coconut Wireless Project teachers are currently translating their teaching into a series of web pages—a process that is flexible and iterative, and that capitalizes on technology that already exists in their school. Logistics and training must be addressed in next steps, but at this exploratory stage, the teachers are learning ways to use their own technology to select and edit information and build their own web pages.

In addition to acquiring technical skills, these teachers stressed that the Coconut Wireless Project has led them to take on new roles in their school. They now see themselves as collaborators (with each other as well as with other teachers) and as professional developers. They report that many of their peers have approached them for assistance with lesson planning, and to learn more about and use the materials developed. The teachers remain enthusiastic about continuing and expanding the project to more faculty and staff. We believe that the keys to this project's success are identifiable and are important to share. We summarize them in Table 6.

TABLE 6. ELEMENTS OF SUCCESS IN THE COCONUT WIRELESS PROJECT

- A group of committed teacher leaders
- Support from the site administrator (principal or other)
- Outside support (desirable, but maybe not necessary)
- Pedagogical and cultural knowledge of teachers
- Adequate technological infrastructure or the flexibility to improve the existing infrastructure
- Adequate computer equipment
- Community support
- A local person with technology expertise
- Flexibility and patience

The rich example presented in this paper is intended to help extend the knowledge base to which teachers have access and thus to help improve teachers' capacities to conceptualize culturally appropriate instruction. In two years, the Coconut Wireless teachers have seen the value of using their own classroom-based examples to illustrate theory. We believe that the field will not move forward without these kinds of expanded data, which provide images and show possibilities to teachers. We hope that other educators will review this work and envision potential applications in their own environments, recognizing that the particulars will be specific to their own cultural contexts. Continuation of this work has the potential to deepen and broaden the disciplinary and pedagogical knowledge of teachers and promote school cultures supportive of all students.

A NOTE ABOUT THE ROLE OF CONSULTANTS

WestEd staff has worked directly with CNMI educators and PREL staff for several years. Prior to the beginning of the Coconut Wireless Project, we carried out the following activities:

- Visited schools throughout the CNMI;
- Conducted assessment discussion sessions with many administrators and teachers;
- Collected important information about the standards and assessment work in the U.S.-affiliated Pacific region;
- Presented several workshops on culturally responsive instruction and assessment.

This work included documenting ways in which Pacific teachers draw upon local language and culture and take into account their students' cultural and linguistic strengths in order to teach successfully. Using this information, we began to create narrative descriptions of culturally responsive pedagogy, particularly instruction that capitalizes on CNMI students' culture-based science knowledge.

We believe that it is necessary to spend considerable time listening and observing in order to be of assistance in a new cultural environment. Outside consultants can never understand a culture in the way its members can, but they can serve in useful roles if they work mutually with those inside the culture. Outside consultants can serve as catalysts, as cultural sounding boards, and as sources of specific technical support.

In the first role, as catalysts, outside consultants may stimulate school or district personnel (or a few key teachers) to consider an innovation they may not know much about but find exciting, positive, and in line with school goals. In the second role, as sounding boards, outside consultants may hear or observe things that cultural insiders in the community or school take for granted. For instance, by asking how the community's culture is incorporated in pedagogy, they may provide members of that culture with new opportunities to reflect on accepted school practices; in a sense, the "naïve" questions of outsiders can present a chance for re-examination. Of course, for a consultant to be an effective sounding board, he or she must have some knowledge of the culture and must demonstrate respect and sensitivity. The third role, as sources of technical assistance, is seemingly the most straightforward. However, technical assistance is not context-free. Successful technical assistance, such as helping set up a web-based communication system, requires an understanding of local context and needs. It makes sense only to the degree that local educational goals and means are understood—something that depends, of course, on an ongoing process.

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